

in fig. 26. This governor is mounted upon the crank-shaft on the side remote from the driving end, and the eccentric drives the valve gear through a rocking shaft fixed upon the frame.

Diagrams such as fig. 43 (p. 128) may be used for investigating the properties of any kind of governor, whether working in a horizontal or a vertical position, and whether controlled by springs or by gravity or by a combination of both.

## CHAPTER II

### Marine Engines

**Introduction.**—Although the reciprocating marine engine has been submitted to very keen competition from the steam turbine, and more latterly from the internal-combustion engine, there are many engineers who still prefer the reciprocating steam-engine for medium and low-powered vessels on the grounds of reliability and general convenience in working. Even on the score of total running costs, including coal consumption, which is the final test applied by shipowners, a well-designed quadruple-expansion job can compete not unfavourably with geared turbines in sister ships when all-round expenses are taken into account, whilst capital cost is considerably less.

The modern marine engine has become very much standardized, and the various makes differ from each other principally in minor points.

The usual type of engine for a modern-sized cargo-steamer is of the triple-expansion vertical design, the quadruple-expansion type being used in intermediate boats carrying both passengers and cargo.

The cylinders are invariably placed above the crank-shaft and carried on columns supported by the bedplate which carries the crank-shaft. The air pumps, often of the Edwards type, are driven from one of the main cross-heads, and the condenser is now always a separate cylindrical structure usually of steel plate and supported from the back columns, but there are various special makes of condenser in the market.

The Michell thrust block is largely displacing the horse-shoe collar type

which has been so long in use.

Steam pressures have gradually increased, and are 160 to 200 Ib. per square inch for triple-expansion, and 205 to 220 for quadruple-expansion engines.

Superheat has come into extensive use, giving considerably improved economy.

The ratio of the low-pressure to high-pressure cylinder is from 6-5 to 8 for triple-expansion engines and from 8 to 9-5 for quadruple-expansion engines with the intermediate cylinders geometrically proportionate. The mean pressures in pounds per square inch referred to low-pressure cylinders